

XVIII.—*Proposed Arrangement of the Echinodermata, particularly as regards the Crinoidea and a Subdivision of the Class Adelostella (Echinidæ).* By THOMAS AUSTIN, Esq., and THOMAS AUSTIN, Jun.

HAVING been engaged for several years past in investigating the *Crinoidea*, both recent and fossil, as well as the *Echinodermata* generally, we have arrived at the conviction that the existing classification cannot with propriety be applied to fossil species, we therefore purpose to adopt in our proposed monograph on the *Crinoidea* the arrangement as now submitted.

The numerous works which have already appeared, or are in progress, respecting the *Echinodermata*, would, it might be supposed, render further observations on the subject superfluous; but as these works are mostly at variance with each other, and not unfrequently with themselves as regards the extent and limits of the different families belonging to this extensive and highly interesting class of animals, we are induced to offer a few observations on the want of a proper general arrangement of the *Echinodermata*, whereby every attempt at their classification on a sure and solid foundation has in every instance signally failed. Professor Forbes has, it is true, in his very interesting work (*History of British Starfishes and other animals of the class Echinodermata*) thrown them into natural groups, but then the characters he has assigned to the *Crinoidea* and *Echinidæ* would, if followed, exclude our numerous fossil species from their proper station in the animal kingdom.

It is with considerable diffidence we venture to dissent from such justly approved authors as Mr. Forbes and some others who have written on the *Echinodermata*; but as their views, if strictly observed, would place our interesting fossil species "nowhere," we have no choice left but to propose an arrangement of our own, founded on characters which we hope will exclude none that properly belong to the *Echinodermata*; and though we feel diffident as to our abilities in being able to make our proposed classification sufficiently intelligible, we feel none whatever as to our motive, which is, if possible, to place the nomenclature relating to the *Echinodermata* on a solid basis, whereby the views of the zoologist and the palæontologist may be in unison, and not run counter to each other as is too frequently the case; and also to plead in behalf of an interesting and much maligned class of animals, and to demand that they may be allowed to take rank and precedence in the animal kingdom according to strict justice,

and that their inalienable natural rights may be preserved intact.

Our objections to Professor Forbes's arrangement chiefly apply to the characters of his divisions, which, however natural they may be as regards the recent animals, are wanting in reference to the calcareous framework of fossil species, by which alone we can study their organization and arrive at satisfactory conclusions respecting their probable manner of growth, propagation, alimentation, in a word their habits, and the structure and functions of their numerous organs.

The aquiferous system, with its connexion with the organs of progression, which Mr. Forbes makes the sole distinguishing character of his orders, and which he has shown to be wholly wanting in his sixth order *Vermigrada* (*Sipunculidæ*), would, if adopted, exclude our proposed first order *Cionacineti* (fixed *Crinoidea*) from our class *Pinnastella*, as would the distinguishing characteristics of his fourth order *Cirrho-Spinigrada* (*Echinidæ*) exclude our order *Columnidæ* or fixed *Echinidæ*, which contains several genera and species of our class *Adelostella*.

In our proposed arrangement of the *Echinodermata*, we have endeavoured to obviate the difficulties referred to, and to establish our divisions on a combination of anatomical and zoological evidence adduced from the comparison of recent and fossil species.

Synopsis of the proposed arrangement :—

Subkingdom CENTRONIÆ, *Pallas*.

Section ECHINODERMATA.

Body more or less protected by a shelly covering, composed of variously shaped calcareous plates imbedded in the substance, or attached to the surface of the skin. These pieces are formed by the deposition of earthy particles round certain central points, so that when fully developed they observe a well-defined arrangement which is easily traceable into certain distinct forms, each peculiar to its kind. This external covering, though formed of numerous pieces, continues firmly united during the animal's life ; but after death, in consequence of the liability of the investing membrane to destruction, the bone-like plates become incoherent. By the mode of structure pointed out, the increase of the animal as regards the size and number of the plates is duly provided for, and injuries of the shelly coat from external violence are readily repaired by the renewed deposition of calcareous matter.

All the known Echinoderms are marine, and are sustained by animal food.

Class 1. PINNASTELLA (*Austin's MS.*) CRINOIDEA. PINNIGRADA, *Forbes.*

Character of the class. Viscera protected by an external skeleton formed of calcareous plates; mouth surrounded by pinnated rays composed of calcareous joints. Sometimes free, but more frequently permanently attached (dorsally) to other bodies by a jointed flexible column.

Order 1. *Cionacineti*, *Austin's MS.*

Fixed to extraneous objects by a jointed flexible column.

Family 1. APIOCRINOIDEA, *Gray.*

Genus 1. *Eugeniocrinites*, *Miller.*

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| Sp. 1. <i>E. caryophyllatus</i> , <i>Goldfuss.</i> | Sp. 5. <i>E. moniliformis</i> , <i>Münst.</i> |
| 2. <i>E. nutans</i> , <i>Goldf.</i> | 6. <i>E. Hoferi</i> , <i>Münst.</i> |
| 3. <i>E. compressus</i> , <i>Goldf.</i> | 7. <i>E. mespiliformis</i> , <i>Goldf.</i> |
| 4. <i>E. pyriformis</i> , <i>Münster.</i> | |

Genus 2. *Solanocrinites*, *Goldf.*

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| Sp. 1. <i>S. costatus</i> , <i>Goldf.</i> | Sp. 3. <i>S. Jaegeri</i> , <i>Goldf.</i> |
| 2. <i>S. scrobiculatus</i> , <i>Münst.</i> | |

Genus 3. *Apiocrinites*, *Miller.*

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| Sp. 1. <i>A. rotundus</i> , <i>Mill.</i> | Sp. 5. <i>A. rosaceus</i> ??? <i>Schloth.</i> |
| 2. <i>A. intermedius</i> , <i>Pearce.</i> | 6. <i>A. mespiliformis</i> ? <i>Goldf.</i> |
| 3. <i>A. elongatus</i> , <i>Pearce.</i> | 7. <i>A. Milleri</i> ?? <i>Schloth.</i> |
| 4. <i>A. ellipticus</i> , <i>Mill.</i> | 8. <i>A. flexuosus</i> ? <i>Goldf.</i> |

Genus 4. *Holopus*, *D'Orbigny.*

- Sp. 1. *H. Rangii*, *D'Orbigny.*

Family 2. POTERIOCRINOIDEA, *Austin's MS.*

Genus 1. *Poteriocrinites*, *Miller.*

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| Sp. 1. <i>P. crassus</i> , <i>Mill.</i> | Sp. 7. <i>P. rostratus</i> , <i>Aust. MS.</i> |
| 2. <i>P. tenuis</i> , <i>Mill.</i> | 8. <i>P. quinquangularis</i> , <i>Aust. MS.</i> |
| 3. <i>P. granulatus</i> , <i>Phillips.</i> | 9. <i>P. plicatus</i> , <i>Aust. MS.</i> |
| 4. <i>P. Dudleyensis</i> , <i>Aust. MS.</i> | 10. <i>P. dactyloides</i> , <i>Aust. MS.</i> |
| 5. <i>P. minimus</i> , <i>Aust. MS.</i> | 11. <i>P. conicus</i> , <i>Phillips.</i> |
| 6. <i>P. radiatus</i> , <i>Aust. MS.</i> | |

Genus 2. *Isocrinites*, *Phillips.*

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| Sp. 1. <i>I. Egertoni</i> , <i>Phill.</i> | Sp. 5. <i>I. brevidactylus</i> , <i>A. MS. n. sp.</i> |
| 2. <i>I. nobilis</i> , <i>Phill.</i> | 6. <i>I. quinquangularis</i> , <i>Aust. MS.</i> |
| 3. <i>I. tuberculatus</i> , <i>Mill.</i> | n. sp. |
| 4. <i>I. longidactylus</i> , <i>A. MS. n. sp.</i> | 7. <i>I. macrodactylus</i> , <i>Phill.</i> |

Genus 3. *Synbathocrinites*, *Phillips.*

- Sp. 1. *S. conicus*, *Phill.*

Family 3. ENCRINOIDEA, *Austin's MS.*

Genus 1. *Encrinites*, *Miller.*

- Sp. 1. *E. moniliformis*, *Mill.*

Genus 2. *Eucalyptocrinites*, *Goldf.*

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| Sp. 1. <i>E. rosaceus</i> , <i>Goldf.</i> | Sp. 2. <i>E. decorus</i> , <i>Phill.</i> |
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Genus 3. *Cupressocrinites*, Goldf.

- Sp. 1. *C. crassus*, Goldf. Sp. 3. *C. tesseratus*, Goldf.
 2. *C. gracilis*, Goldf.

Genus 4. *Euryocrinites*, Phillips.

- Sp. 1. *E. concavus*, Phill.

Family 4. PENTACRINOIDEA, *Austin's MS.*

Genus 1. *Pentacrinites*, Miller.

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| Sp. 1. <i>P. Caput Medusæ</i> , Mill. | Sp. 7. <i>P. moniliferus</i> , Goldf. |
| 2. <i>P. Briareus</i> , Mill. | 8. <i>P. subsulcatus</i> , Münst. |
| 3. <i>P. Johnsonii</i> , Aust. MS. | 9. <i>P. subteres</i> , Münst. |
| 4. <i>P. basaltiformis</i> , Mill. | 10. <i>P. Milleri</i> . |
| 5. <i>P. tuberculatus</i> , Mill. | 11. <i>P. lepidotus</i> , Aust. MS. |
| 6. <i>P. pentagonalis</i> , Goldf. | 12. <i>P. rotundus</i> , Aust. MS. |

Family 5. MARSUPIOCRINOIDEA, *Austin's MS.*

Genus 1. *Marsupiocrinites*, Phillips.

- Sp. 1. *M. cælatus*, Phill.

Genus 2. *Crotalocrinites*, Austin's MS.

- Sp. 1. *C. rugosus*, Mill.

Family 6. PLATYCRINOIDEA, *Austin's MS.*

Genus 1. *Platycrinites*, Miller.

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| Sp. 1. <i>P. lævis</i> , Mill. | Sp. 8. <i>P. microstylus</i> ? Phill. |
| 2. <i>P. rugosus</i> , Mill. | 9. <i>P. laciniatus</i> , Gilb. |
| 3. <i>P. striatus</i> , Mill. | 10. <i>P. mucronatus</i> , Aust. MS. |
| 4. <i>P. granulatus</i> , Mill. | 11. <i>P. antheliontes</i> , Aust. MS. |
| 5. <i>P. elongatus</i> , Gilbertson. | 12. <i>P. spinosus</i> , Aust. MS. |
| 6. <i>P. gigas</i> , Phill. | 13. <i>P. trigintidactylus</i> , Aust. MS. |
| 7. <i>P. interscapularis</i> , Phill. | 14. <i>P. ellipticus</i> , Phill. |

Genus 2. *Cyathocrinites*, Miller.

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| Sp. 1. <i>C. planus</i> , Mill. | Sp. 6. <i>C.?</i> conicus, Phill. |
| 2. <i>C. geometricus</i> , Goldf. | 7. <i>C. bursa</i> , Phill. |
| 3. <i>C. distortus</i> ? Gilb. | 8. <i>C.?</i> capillaris, Phill. |
| 4. <i>C. mamillaris</i> , Phill. | 9. <i>C.?</i> goniodactylus, Phill. |
| 5. <i>C. calcaratus</i> , Phill. | 10. <i>C. pinnatus</i> , Goldf. |

Genus 3. *Caryocrinites*, Say.

- Sp. 1. *C. ornatus*, Say. Sp. 2. *C. loricatus*, Say.

Family 7. ACTINOCRINOIDEA, *Austin's MS.*

Genus 1. *Actinocrinites*, Miller.

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| Sp. 1. <i>A. lævis</i> , Mill. | Sp. 7. <i>A. cataphractus</i> , Aust. MS. |
| 2. <i>A. triacontadactylus</i> , Mill. | 8. <i>A. aculeatus</i> , Aust. MS. |
| 3. <i>A. polydactylus</i> , Mill. | 9. <i>A. crassus</i> , Aust. MS. |
| 4. <i>A. Gilbertsoni</i> , Mill. | 10. <i>A. granulatus</i> , Aust. MS. |
| 5. <i>A.?</i> retiarius, Phill. | 11. <i>A. lævissimus</i> , Aust. MS. |
| 6. <i>A. elephantinus</i> , Aust. MS. | 12. <i>A. longispinosus</i> , Aust. MS. |

Genus 2. *Rhodocrinites*, Miller.

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| Sp. 1. <i>R. calcaratus</i> , Phill. | Sp. 5. <i>R. costatus</i> , Aust. MS. |
| 2. <i>R.?</i> echinatus, Goldf. | 6. <i>R. granulatus</i> , Aust. MS. |
| 3. <i>R. mamillaris</i> , Phill. | 7. <i>R.?</i> mutabilis, Aust. MS. |
| 4. <i>R. bursa</i> , Phill. | |

Genus 3. *Melocrinites?* Goldf.

- Sp. 1. *M. ? hieroglyphicus, Goldf.* Sp. 3. *M. ? gibbosus, Goldf.*
 2. *M. ? lævis, Goldf.*

Genus 4. *Tetracrinites, Austin's MS.*

- Sp. 1. *T. formosus, Aust. MS.*

Family 8. *PERIECOCRINOIDEA, Austin's MS.*

Genus 1. *Periecocrinites, Austin's MS.*

- Sp. 1. *P. costatus, Aust. MS.* Sp. 3. *P. globosus, Aust. MS.*
 2. *P. articulatus, Aust. MS.*

Genus 2. *Sagenocrinites, Austin's MS.*

- Sp. 1. *S. expansus, Phill.* Sp. 2. *S. giganteus, Aust. MS.*

Family 9. *MEROCRINOIDEA.*

Genus 1. *Dimerocrinites, Phill.*

- Sp. 1. *D. decadactylus, Phill.* Sp. 2. *D. icosidactylus, Phill.*

Genus 2. *Tetramerocrinites, Austin's MS.*

- Sp. 1. *T. simplex, Aust. MS.*

There are several other families and genera containing many species under consideration.

Order 2. *Liberidæ, Austin's MS.*

The animals of this order differ but slightly in their general structure from those in the preceding one. They however possess the power of free motion; are either permanently unattached or become so in their mature state. Some species are furnished with a tapering column, which enables the animal to attach itself to extraneous objects, or to detach itself at will, and move freely through the water.

Family 1. *GNATHOCRINOIDEA, Austin's MS.*

Genus 1. *Gnathocrinites, Austin's MS.*

- Sp. 1. *G. fusiformis, Aust. MS.*

Family 2. *ASTRACRINOIDEA, Austin's MS.*

Genus 1. *Astracrinites, Austin's MS.*

- Sp. 1. *A. tetragonus, Aust. MS.*

Genus 2. *Aporocrinites, Austin's MS.*

- Sp. 1. *A. gyratus, Aust. MS.*

Family 3. *COMASTELLA, Austin's MS.*

Genus 1. *Comatula, Lamarck.*

- Sp. 1. *C. pinnata, Goldf.* Sp. 4. *C. filiformis, Goldf.*
 2. *C. tenella, Goldf.* 5. *C. rosacea, Link.*
 3. *C. pectinata, Goldf.* &c. &c.

Genus 2. *Marsupites, Mantell.*

- Sp. 1. *M. ornatus, Miller.*

Class 2. *OLENESTELLA, Aust. MS.* *SPINIGRADA, Forbes.*

Body covered with calcareous scales or plates; mouth surrounded

by simple or dichotomous rays (not pinnate) furnished with spines, which are used as organs of motion.

Class 3. LOBISTELLA, *Austin's MS.* CIRRHIGRADA, *Forbes.*

Body more or less covered with calcareous scales or plates; mouth not surrounded by arms; body lobed and channeled for cirrhi.

Class 4. ADELOSTELLA, *Austin's MS.* CIRRHI-SPINIGRADA, *Forbes.*

Body covered with closely-jointed calcareous plates, not lobed, and without arms, sometimes furnished with a calcareous flexible jointed column, but most of the class are free.

Order 1. *Echinidæ.*

Animal free, furnished with series of ambulacral pores for the protrusion of cirrhi, which, in connection with spines attached by ligaments to the plated skeleton, constitute the organs of motion.

Order 2. *Columnidæ,* *Austin's MS.*

Animal attached by a jointed flexible calcareous column to extraneous bodies; ambulacral pores sometimes wanting, in other instances they are scattered irregularly among the plates?, but they are usually in regular series, as in the order *Echinidæ*; surface mostly covered with spines, though occasionally smooth.

Family 1. SPHÆRONOIDEÆ, *Gray.*

Genus 1. *Sphæronites.*

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| Sp. 1. <i>S. tessellatus, De la Beche.</i> | Sp. 3. <i>S. pomum.</i> |
| 2. <i>S. aurantium.</i> | &c. &c. |

Genus 2. *Sycocrinites,* *Austin's MS.*

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| Sp. 1. <i>S. clausus, Aust. MS.</i> | Sp. 3. <i>S. anapeptamenus, Aust. MS.</i> |
| 2. <i>S. Jacksoni, Aust. MS.</i> | |

Family 2. ECHINOCRINOIDEA, *Austin's MS.*

Genus 1. *Echinocrinus,* *Agassiz.*

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| Sp. 1. <i>E. pomum, Agass.</i> | Sp. 3. <i>E. anceps, Aust. MS.</i> |
| 2. <i>E. spinosus, Aust. MS.</i> | 4. <i>E. cidariformis? Aust. MS.</i> |

Genus 2. *Pentremites,* *Say.*

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| Sp. 1. <i>P. inflatus.</i> | Sp. 5. <i>P. acutus, Gilb.</i> |
| 2. <i>P. pyriformis, Say.</i> | 6. <i>P.? astriformis, Aust. MS.</i> |
| 3. <i>P. florealis.</i> | 7. <i>P. pentangularis.</i> |
| 4. <i>P. ovalis, Goldf.</i> | |

Genus 3. *Orbitremites.*

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| Sp. 1. <i>O. globosus.</i> | Sp. 4. <i>O. angulatus? Gilb.</i> |
| 2. <i>O. Derbiensis, Sow.</i> | 5. <i>O. oblongus, Gilb.</i> |
| 3. <i>O. ellipticus, Sow.</i> | |

Class 5. ASCIDIASTELLA, *Austin's MS.* CIRRHI-VERMIGRADA, *Forbes.*

The animals of this class deviate considerably from those in the preceding ones. As spines are wanting, motion is effected by rows

of cirrhi, aided by the contraction and extension of the animal's body. The tentaculated mouth forms a prominent feature in its organization.

Class 6. VERMISTELLA, *Aust. MS.* VERMIGRADA, *Forbes.*

The cirrhi, which constitute in part the organs of motion in the fifth class, are wholly wanting in this; the alternate contraction and extension of the animal's body alone effecting progression.

It will be seen on reference to the foregoing arrangement of the *Crinoidea* that several genera and species have been suppressed or unacknowledged. This has not been done without due consideration, but as it would extend this paper, already too long, to an unreasonable length to discuss all the facts which have led to the proposed alteration, we shall merely observe, that some writers on the *Crinoidea* have founded genera and species on imperfect evidence, such as minute fragments of columns, seldom to be relied on, while others have taken the shape, into which the particular specimen they described from may have been squeezed into or contorted by violence at its death, or during its subsequent entombment in the strata, as the data on which to found generic and specific distinctions. If such evidence as this is to be admitted as legitimate grounds to proceed on, we could undertake to double the number of species heretofore described without going beyond the limits of our own cabinet for specimens. Others, in their anxiety to correct the errors of preceding writers, have sometimes fallen into mistakes of equal importance when re-founding genera. When this has been clearly the case, we have retained the original name whenever it could be done with propriety. In other cases we have retained the specific name only as given by the founder of the species.

Several unnoted genera and many species are still under consideration.

Among the varied forms observable in the *Crinoidea*, we can trace them step by step as it were merging from their ancient prototypes to their existing analogues of the recent seas. The genus *Echinocrinus*, founded by Professor Agassiz, is not the least remarkable among these forms as the precursors of the *Echinites*. Another genus (*Astracrinites* of our MS.) offers so many affinities to the recent and fossil *Echinodermata*, that we consider it the most remarkable of all the known genera. By its being lobed it approaches to the *Lobistella*; its ambulacra, spines and anus mark it as allied to the *Echinites*, while the arrangement of its calcareous plates connect it with the Lilies of the ocean. In short it possesses the lobes of a starfish, the ambulacra and spines of a sea-urchin, and the plates

of a Crinoid. It is further remarkable by deviating from the quinary type so prevalent in the *Echinodermata*: the lobes and ambulacra of this new genus are each four in number.

We have taken the number and arrangement of the plates surrounding the body as the leading characters on which to found our genera, as we have the variations in their form and other observable peculiarities, together with the number of rays or arms to distinguish the different species. Though the mouth of some of our species is central and but slightly protrusive, and in others it assumes the form of an elongated proboscis, yet we have not at present deemed this difference sufficient to found new genera on, when the plates surrounding the body agree in number, shape and general arrangement; nor have we separated those with the mouths placed laterally, if the other points coincide generally. Had these characters been acted on, we must have divided some long-established genera into no less than three, each differing in this particular. The question is however under consideration as to the propriety of continuing the present arrangement in the cases alluded to.

XIX.—*Descriptions of Chalcidites discovered by C. Darwin, Esq., near Valparaiso.* By FRANCIS WALKER, F.L.S.

Torymus, Phormio, Fem. *Viridi-æneus*, antennæ nigræ, pedes rufi, femora viridia, alæ sublimpidæ.

Corpus viridi-æneum, convexum, nitens, scite squameum, parce pubescens: caput transversum, breve, thorace vix latius; vertex sat latus; frons abrupte declivis, excavata: oculi rufi, mediocres, non extantes: antennæ nigræ, subclavatæ, pubescentes, thorace paullo breviores; articuli approximati: thorax longi-ovatus: prothorax transversus, mediocris, antice non angustior: mesothoracis scutum latitudine paullo longius; parapsidum suturæ bene determinatæ, postice approximata; scutellum subovatum: metathorax mediocris, declivis, obconicus: petiolus brevissimus: abdomen longi-ovatum, subcompressum, subtus carinatum, thorace paullo brevius: oviductus exertus, rufus; vaginæ nigræ, abdomine vix breviores: pedes pallide rufi; coxæ virides; femora viridia; ungues et pulvilli fusci; metafemora subtus unidentata, metatibiæ pallide fuscæ, apice spina longa arcuata armatæ: alæ sublimpidæ; squamulæ piceæ; nervi fusci; nervus humeralis ulnari fere duplo longior; radialis ulnari brevior, cubitalis brevissimus; stigma minutum. (Corp. long. lin. $1\frac{1}{2}$; alar. lin. $2\frac{3}{4}$.)

Callimome Nonacris, Fem. *Viridi-cyaneus*, antennæ nigræ, pedes fusci, femora viridia, alæ sublimpidæ.

Corpus viridi-cyaneum æneo-varium, convexum, scite squameum, parum nitens, parce pubescens: caput transversum, breve, thoracis latitudine; vertex sat latus; frons abrupte declivis: oculi rufi, mediocres, non extantes: antennæ nigræ, validæ, clavatæ, pubescentes, thorace non longiores: thorax longi-ovatus: prothorax sat magis longitudine paullo latius, antice angustior: mesothoracis scutum latitudine paullo longius; parapsidum suturæ bene determinatæ, postice approximata; scutellum subovatum: metathorax